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ABSTRACT

This paper reports on the results of a class experiment in which advanced Human Anatomy and Physiology and beginning General Biology science students selected a science project using art as the medium of expression and demonstration. Students were allowed to select their own project, with the instructor's approval. Once a project was decided upon, students were allowed to work independently or in small, self-selected project groups and given 3-4 weeks to complete the project. Before the project selection, students completed two assessment instruments: the Self Index of Modality Tendencies and the Teaching Learning Preference Inventory. Students were given their instrument results and encouraged to work with students with different learning styles. Assessment instrument results from both classes were compared. Most students agreed with their assessed learning styles and preferred to work in groups when using visual and manipulative materials in the laboratory setting. Most felt this method reduced their anxiety regarding learning the laboratory materials. In general, it was found that the addition of the hands-on art projects and cooperative learning into the science class helped students to retain information better, be more motivated and creative, and be more interested in class activities. It is suggested that small differences between the results from the two class surveys regarding working alone may be related to differences in the types of materials and the concepts learned in the two classes. Appendixes contain a list of project criteria, questionnaires, and tables. (Contains 16 references.) (NAV)

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ON THE CUTTING EDGE OF CREATIVITY:

THE USE OF ART PROJECTS IN COMMUNITY COLLEGE SCIENCE CLASSES

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ON THE CUTTING EDGE OF CREATIVITY:

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Community colleges typically offer a variety of services and opportunities to enhance the successful advancement of their enrollees. Community college students represent a slice of the diverse service area population. Several courses are offered by many community colleges to insure the student's success (Price, 1993) and the instructors are sensitive to the diverse educational backgrounds of their students. Community college students have a variety of learning styles (Price, 1991, 1992) and preferences regarding cooperative learning groups with many being "hands-on" learners who may learn best (depending on the material to be mastered) while either studying independently or in cooperative groups. A large percentage of community college students (Price, 1994, Price & Herbster, 1994) learn best when actively involved with visual and manipulative materials rather than abstract concepts.

Most science courses contain many abstract concepts involving structures and processes which students must master. Purchased models may be utilized in the course to facilitate students' conceptual learning, for example cell models showing internal parts in both plant and animal cells for general biology classes, or human torso models with removable internal parts for anatomy and physiology classes. The models can be studied by the

students either individually or with other students in cooperative learning groups (Slavin 1989, Watson and Rangel, 1989 and Johnson and Johnson, 1993). Perry (1993) discussed the utilization of student created models in university plant morphology courses and stated that "students who have created models have a clearer mental image of botanical structures when asked to interpret them on exams."

Art prepared by medical illustrators can also be utilized to clarify concepts, microscopic structures and processes according to the scientific journal editor, Rogin (1986) who stated, "Elucidating the intricacies of science is one of our goals." According to Gianfagna (1985) art work allows "many insights to be gathered."

The author in an effort to enhance community college science students' understanding of various scientific concepts and to allow for individual learning style and cooperative group attitudinal diversities assigned projects for General Biology (Bio. 103) and Human Anatomy and Physiology classes (Bio. 201) during Fall Quarter 1994.

METHOD

At the beginning of Fall Quarter 1994 students in the author's General Biology (Bio. 103 [2]) class and Human Anatomy and Physiology (Bio. 201 [2,4,& 501]) classes were shown an author prepared videotape regarding the project criteria (Appendix A), samples of student projects prepared in previous quarters, how well the projects met those criteria. outstanding features of the projects, as well as, suggestions on how to

improve the sample projects. Two instruments were administered to the students: 1) The Self Index of Modality Tendencies (van Nagel, 1984) which reflected visual, auditory and kinesthetic modalities; and 2) The Teaching Learning Preference Inventory (Johnson, 1994.) This instrument reflected the Thinker [needs quiet place to study with written instructions], Intuitor [long uninterrupted time to study and to see pictures/diagrams], Feeler [short time to study and then must talk about material/problems and must feel that learning the material is possible] and Sensor [must study "sandwich" style fitting exercise between study sessions and must have hands on the materials] Learning styles (Johnson, 1994) (Results in Table One). Each student was given his/her results of the inventories and was encouraged to work with students of different learning styles (heterogeneous groups) in small groups for laboratory activities. Occasionally students were assigned to small (2-5 member) heterogenous learning styles groups or allowed to self-select into cooperative study groups for various laboratory activities. Those students who chose to work independently were allowed to do so.

Students were allowed to select their art-science project topic and after it was approved by the instructor they were allowed to work either independently or in small self-selected project groups on the project. They were provided with sculptoring clay and laboratory space if it was desired. After three to four weeks the completed science art projects were brought to class, the project was explained or demsonstrated to the class by the group members or the independently working

individual, and any related handouts were distributed to the class by the project group members. After all projects were completed the Learning Styles Questionnaire (Appendix B) (Price, 1991) and the Projects Survey (Appendix C) (Price 1994) were administered, results recorded, and then analyzed (Ferguson,1981) using percentages (Tables Two through Nine.)

RESULTS AND DISCUSSION

The results of the Learning Styles Questionnaire (Price, 1991) for the Human Anatomy and Physiology (Bio. 201) classes were similar to those of the General Biology (Bio. 103) class for Fall Quarter 1994. Most students regardless of science class tested preferred to know about their learning style and agreed with the results of the learning style instrument. Students agreed with most of the questions, these results reflected that students regardless of whether in the beginning science classes or the advanced classes preferred to work in groups when using visual and manipulative materials in the laboratory setting and that in so doing reduced their anxiety regarding learning the laboratory materials.

Both General Biology (Bio. 103) and Human Anatomy and Physiology (Bio. 201) students disagreed (53.4%, Bio. 201 and 59%, Bio. 103) with Question 9, "I prefer to study alone in the lab," thus showing a preference for cooperative learning in the lab. Both groups also disagreed (Bio. 201, 59%; Bio. 103, 81%) with Question 19, "Working in groups increased my anxiety." The results from Question 13, "My lecture test anxiety was reduced

when I worked with a group of people with different learning styles," had a difference in the degree of agreement and disagreement between the advanced and beginning science classes with 58.3% and 68% agreement and 41.7% and 32% disagreement for Bio. 201 and 103, respectively.

It was of interest to note that Question 20, "I prefer to study lecture material by myself," was answered in the affirmative by both beginning and advanced science classes even though not to the same degree. The advanced science classes, Human Anatomy and Physiology, (Bio. 201) had 84% agreement while the beginning science class, General Biology (Bio. 103) had only 71% agreement.

The Projects Survey (Price, 1994) had similar results for both beginning and advanced science classes (Tables 3, 5, and 7) with the exception of questions 1, 5, and 10. Question 1, "I learned important information while working on the biology/anatomy and physiology project," had 95% and 83% agreement for the general and advanced science classes, respectively. Question 5, "I prefer to work alone on the project," had 25% agreement and 75% disagreement of the general science class and 56.5% agreement and 43.5% disagreement of the advanced class showing the most variation between answers of the groups. Question 10, The project aspect should be continued as a learning experience in the biology/anatomy and physiology classes," had 81% agreement from the general science classes and 72% agreement from the advanced science classes.

The variations in survey results between the general and advanced classes may be related differences in the type materials and concepts which must be learned in both classes. Another explanation may be that the general science class, General Biology (Bio. 103) is required for many of the degree programs and transfer programs of the community college while the advanced science class, Human Anatomy and Physiology (Bio. 201) is specifically required for the degree programs in the health fields. Also the General Biology (Bio. 103) is a prerequisite for the Human Anatomy and Physiology (Bio. 201) class.

The information learned by the students and the life experiences involving cooperative learning are definitely assets to the project phase of the science courses. Students have exhibited creativity and have shown improvement in motivation and increased interest in classroom activities, and have demonstrated on exams increased retention of scientific concepts, especially those related to their own "hands-on" project. With all these positive aspects continuation of the art projects for science classes is definitely indicated.

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APPENDICES

APPENDIX A

CRITERIA FOR PROJECTS

1. DEMONSTRATES A SCIENTIFIC PRINCIPLE OR PROCESS. (25)
2. THREE DIMENSIONAL (15) / MOVING OR WORKING PARTS --BONUS
3. USEFUL AS A TEACHING/LEARNING TOOL. (15)
4. PARTS LABELED WITH A KEY OR EXPLANATION AVAILABLE. (10)
5. STUDENT SHOULD DEMONSTRATE/EXPLAIN THE PROJECT TO THE CLASS. (10)
6. HANDOUTS RELATED TO THE PROJECT FOR OTHER STUDENTS. (5)
7. CREATIVE AND ORIGINAL. (5)
8. COLORFUL. (5)
9. ECONOMICAL. (5)
10. REASONABLE DIMENSIONS. (5)

8/30/94

APPENDIX B

LEARNING STYLES QUESTIONNAIRE (PRICE, 1991)

QUARTER_____YEAR_____ CLASS_____ SECTION_____ DATE_____
MY LEARNING STYLE_____LEARNING STYLES TEST(S) USED_____

LEARNING STYLES QUESTIONNAIRE (Price 1991)

Key: A=Strongly Agree, B=Moderately Agree, C=Slightly Agree
D=Slightly Disagree, E=Moderately Disagree, F=Strongly Disagree
Circle each answer as it best applies to you and your situation.

1.	Finding out about my learning style was important to me.	A B C D E F
2.	The Galt Test helped me identify my learning style. (OR OTHER LEARNING STYLES TEST)	A B C D E F
3.	I agree with the results of the Galt Test. (OR OTHER LEARNING STYLES TEST)	A B C D E F
4.	Working with other students of different learning styles helped me perceive the material in a different way.	A B C D E F
5.	The lab experiences were beneficial to me when I worked with someone who had a different learning style.	A B C D E F
6.	I was able to meet other students in the class much sooner by working in small groups than by not working in small groups.	A B C D E F
7.	I was able to form a study group or found a study partner with whom I work outside of class as a result of the instructor asking us to work in small groups.	A B C D E F
8.	Answering the review lab test questions was more beneficial to me when I worked with another student.	A B C D E F
9.	I prefer to study alone in lab.	A B C D E F
I0.	When studying the models in the lab I learned more when working with another person regardless of their learning styles.	A B C D E F
11.	I learned more in the lab when working with someone whose learning style was different to mine.	A B C D E F
12.	Working in the lab with a group of people whose learning styles were different to mine was beneficial to me.	A B C D E F

13.	My lecture test anxiety was reduced when I worked with a group of people with different learning styles.	A B C D E F
14.	Working with someone of a different learning style helped to reduce my lecture test anxiety.	A B C D E F
15.	Working in groups helped reduce my pop-test anxiety.	A B C D E F
16.	My pop-test anxiety was reduce when I worked with an individual whose learning style differ from mine.	A B C D E F
17.	Working with someone of a different learning style helped to reduce my lab test anxiety.	A B C D E F
18.	My lab test anxiety was reduced when I worked with a group of people with different learning styles.	A B C D E F
19.	Working in groups increased my anxiety.	A B C D E F
20.	I prefer to study lecture material by myself.	A B C D E

APPENDIX C

PLEASE COMPLETE THE FOLLOWING BY CIRCLING THE CORRECT LETTER

PROJECTS SURVEY

A=STRONGLY AGREE
B=MODERATELY AGREE
C=SLIGHTLY AGREE
D=SLIGHTLY DISAGREE
E=MODERATELY DISAGREE
F=STRONGLY DISAGREE
N/A=NOT APPLICABLE (write in if needed)

1.	I learned important information while working on the biology/anatomy and physiology project.	A B C D E F
2.	I enjoyed making the project.	A B C D E F
3.	I felt the project was useful to me.	A B C D E F
4.	I enjoyed working on the project with a partner or partners (if applicable.)	A B C D E F
5.	I prefer to work alone on the project.	A B C D E F
6.	I learn best when working in groups of two or more people.	A B C D E F
7.	The project aspect of the course was a beneficial learning experience.	A B C D E F
8.	The "Hands-On" Project Experience complimented my learning style.	A B C D E F
9.	I learned as much from preparing the project as I would have from studying already prepared models.	A B C D E F
10.	The project aspect should be continued as a learning experience in biology/anatomy and physiology.	A B C D E F

TABLES

TABLE ONE

COMPARING TWO LEARNING STYLES OF ANATOMY AND PHYSIOLOGY STUDENTS(BIO 201) AND GENERAL BIOLOGY (BIO. 103) STUDENTS
FALL QUARTER 1994

I: MODALITIES (VISUAL, AUDITORY, AND KINESTHETIC) (VAN NAGEL, 1984)

II: THINKING AND LEARNING STYLE PREFERENCE (THINKER, FEELER, INTUITOR, AND SENSOR [THINKER+INTUITOR/2=VISUAL, FEELER=AUDITORY, SENSOR=KINESTHETIC) (JOHNSON, 1994)

	I	II
GROUP ONE (BIO. 201 [2]):		
VISUAL	14	17
AUDITORY	6	8
KINESTHETIC	4	3
GROUP TWO (BIO. 201 [4]):		
VISUAL	6	5
AUDITORY	2	3
KINESTHETIC	3	0
GROUP THREE (BIO. 201 [501]):		
VISUAL	12	21
AUDITORY	6	13
KINESTHETIC	9	2
GROUP FOUR (BIO. 103)		
VISUAL	10	9
AUDITORY	4	11
KINESTHETIC	8	8

TABLE TWO
RESULTS OF LEARNING STYLES QUESTIONNAIRE

FALL QUARTER 1994 SCIENCE STUDENTS
BIOLOGY 201
HUMAN ANATOMY AND PHYSIOLOGY 1

A: STRONGLY AGREE
B= MODERATELY AGREE
C= SLIGHTLY AGREE
D= SLIGHTLY DISAGREE
E= MODERATELY DISAGREE
F= STRONGLY DISAGREE

QUESTION	SELECTION:	A	B	C	D	E	F
1		25	22	9	2	2	0
2		17	18	16	4	2	0
3		20	21	12	2	1	2
4		15	22	17	3	1	2
5		14	20	14	5	3	3
6		29	18	7	3	3	0
7		12	16	14	5	9	3
8		29	13	8	6	3	1
9		13	5	9	7	3	21
10		26	13	10	3	1	4
11		11	17	18	10	3	1
12		12	19	16	7	3	3
13		5	12	18	13	1	11
14		8	9	16	14	3	10
15		12	12	15	13	2	8
16		10	8	21	10	4	7
17		8	11	16	12	4	8
18		7	12	15	13	4	8
19		6	11	7	10	11	14
20		29	12	10	3	1	6

TABLE THREE

PROJECTS SURVEY
BIOLOGY 201
FALL QUARTER 1994

QUESTION	SELECTION:	A	B	C	D	E	F
1		30	14	6	6	3	1
2		23	10	13	8	4	3
3		19	14	14	4	6	1
4		21	9	9	4	2	4
5		21	8	6	6	3	18
6		19	15	7	6	6	4
7		21	13	12	4	6	5
8		19	17	10	8	2	3
9		17	12	15	3	5	9
10		21	13	10	4	4	9

TABLE FOUR
RESULTS OF THE LEARNING STYLES QUESTIONNAIRE
ANATOMY AND PHYSIOLOGY I (BIO. 201)

QUESTIONS (NUMBER)	AGREE (A+B+C)	DISAGREE (D+E+F)
1	93%	7%
2	89.5%	10.5%
3	93%	7%
4	90%	10%
5	81.4%	18.6%
6	90%	10%
7	71%	29%
8	83.3%	16.7%
9	46.6%	53.4%
10	86%	14%
11	77%	23%
12	78%	22%
13	58.3%	41.7%
14	55%	45%
15	63%	37%
16	65%	35%
17	59%	41%
18	58%	42%
19	41%	59%
20	83.6%	16.4%

TABLE FIVE

RESULTS OF THE PROJECTS SURVEY
ANATOMY AND PHYSIOLOGY (BIO. 201) FALL 1994

QUESTIONS (NUMBER)	AGREE (A+B+C)	DISAGREE (D+E+F)
1	83%	17%
2	75%	25%
3	80%	20%
4	79.6%	20.4%
5	56.5%	43.5%
6	73%	28%
7	75%	25%
8	78%	22%
9	72%	28%
10	72%	28%

TABLE SIX

RESULTS OF THE LEARNING STYLES QUESTIONNAIRE
FOR GENERAL BIOLOGY (BIO. 103)
FALL QUARTER 1994

QUESTIONS	SELECTIONS:	A	B	C	D	E	F
1		8	6	7	1	1	0
2		4	6	8	3	2	0
3		2	8	10	2	1	0
4		9	6	5	1	2	0
5		7	5	8	0	1	0
6		13	2	5	1	1	0
7		5	1	4	3	3	5
8		6	4	6	5	1	1
9		1	3	5	0	3	10
10		9	5	4	1	2	1
11		5	4	9	2	0	2
12		4	6	8	3	0	1
13		2	4	9	2	3	2
14		1	1	11	3	4	3
15		6	2	8	0	2	4
16		4	6	6	2	1	2
17		3	4	8	2	2	1
18		3	5	8	2	1	2
19		0	1	3	5	3	9
20		9	1	5	0	4	2

TABLE SEVEN

RESULTS OF PROJECTS SURVEY FOR GENERAL BIOLOGY (BIO. 103)
FALL QUARTER 1994

QUESTION	SELECTION:	A	B	C	D	E	F
1		10	6	5	0	0	1
2		11	5	4	0	1	1
3		12	1	4	1	3	1
4		13	2	1	2	0	1
5		2	1	2	2	4	9
6		7	6	6	0	2	1
7		6	4	6	1	2	2
8		9	8	4	0	1	1
9		3	3	6	1	3	5
10		10	4	3	0	0	4

TABLE EIGHT

RESULTS OF THE LEARNING STYLES QUESTIONNAIRE
GENERAL BIOLOGY (BIO. 103)
FALL QUARTER 1994

QUESTIONS (NUMBER)	AGREE (A+B+C)	DISAGREE (D+E+F)
1	91%	9%
2	78%	22%
3	87%	13%
4	87%	13%
5	95%	5%
6	91%	9%
7	48%	52%
8	91%	9%
9	41%	59%
10	82%	18%
11	82%	18%
12	82%	18%
13	68%	32%
14	56.5%	43.5%
15	71%	29%
16	76%	24%
17	75%	25%
18	76%	24%
19	19%	81%
20	71%	29%

TABLE NINE

RESULTS OF PROJECTS SURVEY
GENERAL BIOLOGY (BIO. 103)
FALL 1994

QUESTIONS (NUMBER)	AGREE (A+B+C)	DISAGREE (D+E+F)
1	95%	5%
2	91%	9%
3	77%	23%
4	84%	16%
5	25%	75%
6	86%	14%
7	76%	24%
8	91%	9%
9	57%	43%
10	81%	19%